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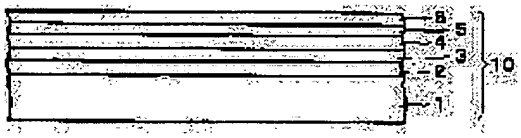
(54) MAGNETIC RECORDING MEDIUM

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a magnetic recording medium having excellent recording resolution and medium S/N by enhancing thermal fluctuation resistance without intensifying a head magnetic field.

SOLUTION: The value of $Hk/4\pi Ms$ calculated with an anisotropic magnetic field Hk and saturated magnetization Ms of a medium is specified to be 2-5.



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CLAIMS

[Claim(s)]
[Claim 1] It is the magnetic-recording medium characterized by being a thing with the magnetic properties from which the value of Hk/4piMs by which the aforementioned perpendicular magnetic layer is computed from an anisotropy field Hk and the amount Ms of saturation magnetization in the magnetic-recording medium which has a substrate and the perpendicular magnetic layer formed on the substrate concerned is set to 2 or 5.
[Claim 2] The aforementioned perpendicular magnetic layer is the magnetic-recording medium of ** to the claim 1 made into a CoPtCtO principal component.
[Claim 3] It is the magnetic recorder and reproducing device characterized by having a perpendicular magnetic layer with the magnetic properties from which the value of Hk/4piMs by which the aforementioned magnetic-recording medium is computed from an anisotropy field Hk and the amount Ms of saturation magnetization in the magnetic recorder and reproducing device possessing a magnetic-recording medium, the driving means which support and drive [rotation] the aforementioned magnetic-recording medium, and the magnetic head which performs informational record reproduction to the aforementioned magnetic-recording medium is set to 2 or 5.

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the magnetic-recording medium used for the magnetic recorder and reproducing device of vertical magnetic recording, and this.
[0002]
[Description of the Prior Art] When it is going to raise the recording density of magnetic recording, it is becoming clear that coexistence of reducing a medium noise and saying [raising heat fluctuation resistance] is a problem.
[0003] One of the solution method of this is using the material which raised the anisotropy energy of a medium magnetic film. However, if material with the large amount of saturation magnetization is used, a static magnetism interaction will become large, without the problem that it cannot write in enough by the recording head arising and enlarging a magnetic-anisotropy magnetic field, if the material which enlarged the magnetic-anisotropy magnetic field is used in order to raise the anisotropy energy of a medium magnetic film, and a problem that the reduction in a noise is difficult arises.
[0004] On the other hand, the vertical magnetic recording which records magnetization perpendicularly is examined from the former. In order for the anti-magnetic field from a contiguity bit not to work to a magnetization transition region like the record within a field by this method but to work from a contiguity bit conversely in the direction by which magnetization is stabilized in a magnetization transition region, in a high-density record state, it is stable, and is because it is thought that it is advantageous to high-density record. Recently, since the high resolution also maintained thick thickness as compared with the record medium within a field, it was thought also in heat fluctuation resistance that this vertical recording was advantageous, it attracted attention also from this point, and came for the first time. However, in the case of vertical recording, it is strongly influenced of an anti-magnetic field within a self-bit by the thin film size effect, and it is reported to it by low density at the low density side that the fall of a reproduction output is more large. Therefore, it is necessary also about vertical recording to examine heat-resistant fluctuation nature.
[0005] Although the two-layer film medium using the soft-magnetism film comparatively thick under a record layer is also examined, it is pointed out that there is a fault with large magnetic field interference. Also in a vertical-magnetic-recording medium, although it becomes effective like the medium within a field to raise the anisotropy energy of a magnetic film, if an anisotropy is enlarged more than required, the writing by the head will become difficult. Therefore, the device which does not raise anisotropy energy more than required is needed by equalizing heat fluctuation resistance about a magnetic-film particle.
[0006]
[Problem(s) to be Solved by the Invention] made in order that this invention may solve the above-mentioned trouble, the 1st purpose improves heat fluctuation resistance in the magnetic-recording medium used for a vertical recording method, without raising a head magnetic field -- making -- record -- it is in offering the good magnetic-recording medium of resolution and medium S/N
[0007] moreover, the 2nd purpose of this invention improves heat fluctuation resistance, without raising a head magnetic field -- making -- record -- it is in offering the magnetic recorder and reproducing device which can perform good magnetic recording of resolution and medium S/N
[0008]
[Means for Solving the Problem] In the magnetic-recording medium by which this invention has the perpendicular magnetic layer formed [1st] on the substrate and the substrate concerned, the magnetic-recording medium characterized by the aforementioned perpendicular magnetic layer being a thing with the magnetic properties from which the value of Hk/4piMs computed from an anisotropy field Hk and the amount Ms of saturation magnetization is set to 2 or 5 is offered.

[0009] In the magnetic recorder and reproducing device in which this invention possesses the driving means which support and drive [rotation] a magnetic-recording medium and the aforementioned magnetic-recording medium the 2nd, and the magnetic head which performs informational record reproduction to the aforementioned magnetic-recording medium, the aforementioned magnetic-recording medium offers the magnetic recorder and reproducing device characterized by to have a perpendicular magnetic layer with the magnetic properties from which the value of Hk/4piMs computed from an anisotropy field Hk and the amount Ms of saturation magnetization is set to 2 or 5.
[0010]
[Embodiments of the Invention] The magnetic-recording medium of this invention is characterized by the value of Hk/4piMs calculated from the amount Ms of magnetization which is the magnetic-recording medium which has a perpendicular magnetic layer, and the anisotropy field Hk and its magnetic particle have on a substrate being 2 or 5.
[0011] Moreover, the magnetic-recording medium of this invention is characterized by providing the driving means which support and drive [rotation] an above-mentioned magnetic-recording medium and an above-mentioned magnetic-recording medium, and the magnetic head which performs informational record reproduction to a magnetic-recording medium.
[0012] By the magnetic-recording medium of a vertical recording method, if Ms is enlarged, although a magnetic anisotropy becomes large, in a magnetic film, distribution of Ms value will exist by dispersion in composition etc., and this will cause the ununiformity of anisotropy energy. However, at this time, by specifying Hk/4piMs to 2 or 5, anisotropy energy change of a particle is set off against change of an anti-magnetic field, and the heat fluctuation resistance of each particle is equalized. making heat fluctuation resistance of each magnetic particle of the same grade by specifying the value of Hk/4piMs as mentioned above according to this invention -- with [of a magnetization changes position] a rose -- being lost -- magnetization changes -- sudden ** -- becoming -- record -- resolution improves, a medium noise decreases and medium S/N improves
[0013] Moreover, as for the value of the above-mentioned Hk/4piMs, it is desirable that it is 2.5 or 4.5.
[0014] Furthermore, as for a magnetic layer, considering as a CoPtCrO principal component is desirable.
[0015] Hereafter, this invention is explained in detail with reference to a drawing.
[0016] The magnetic-recording medium for vertical recording concerning this invention was created as follows.
[0017] The cross section which expresses an example of the composition of the magnetic-recording medium concerning this invention to drawing 1 is shown.
[0018] The magnetic-recording medium 10 shown in drawing 1 has the structure which formed the seed layer 2, the ground layer 3, the perpendicular magnetic film 4, the protective coat 5, and the lubricating layer 6 in order on the substrate 1.
[0019] First, after forming Ti system seed layer 2 and Ru system ground film 3, using the diameter chemical-strengthening alumino of 2.5 inch, and a silica glass as a substrate 1 in order to improve perpendicular orientation, using the CoPtCr system target, the CoPtCrO system perpendicular magnetic film 4 was formed by the spatter, for example, the protective coats 5, such as carbon, and the lubricating layers 6, such as a perphloro polyether, were formed in order, and the magnetic-recording medium 10 was obtained.
[0020] The magnetic property of this magnetic-recording medium was measured with the oscillating sample type magnetometer (VSM), and time change deltaMr/Mr of residual magnetization Mr estimated heat fluctuation resistance.
[0021] At this time, Hk measured MH loop within a field, asked for the curve which averaged + magnetization impression and - magnetization impression side, and defined it by the magnetic field in case the straight line which connected the point that a magnetization layer is set to two thirds of saturation magnetization Ms on this curve, and the zero serves as the amount of saturation magnetization.
[0022] Moreover, after impressing the magnetic field of 1440 A/m at once, change of Mr measured change of Mr, where a magnetic field is removed, and moreover it asked for change of Mr of after (6000 seconds and 9000 seconds), it evaluated over-writing modulation (OWM) and medium S/N for this medium in combination with ring type record and the GMR reproducing head.
[0023] Membranous magnetic properties were controlled by changing Cr composition / film production conditions of a CoPtCr target. OWM recorded and measured 200FCI(s) on 100kFCI to the record current from which the output of 10kFCI serves as the maximum.
[0024] Moreover, 1-micrometer width of recording track was converted and asked for medium S/N as a ratio of the peak to peak value of the dipulse of obtained 10kFCI(s), and a rms noise value.
[0025] Moreover, the graphical representation showing a relation with OWM at the time of changing Hk to drawing 2 is shown.
[0026] When OWM considers as the conditions which can be taken 32dB or more in the case of record so that it may illustrate, it sets about the combination of this head and this CoPtCrO system perpendicular magnetic layer, and Hk is

960K. It is below an A/m grade and it turns out that it is good.
[0027] Then, Hk is 960K. About the thing of the target composition used as an A/m grade, the medium into which film production conditions were changed was produced. Cr composition at this time was 16at%, and Pt was 20at(s)%. Moreover, the oxygen density in a film was 30at%.
[0028] About these, time change (deltaMr/Mr) of the amount Mr of residual magnetization was measured as medium S/Nm and heat fluctuation resistance evaluation. moreover, record -- PW50 (nm) which gives resolution differentiated the isolated regenerative signal, and asked for it from the half-value width
[0029] Hk of the produced medium, 4piMs and Hk/4piMs, medium S/N and heat fluctuation resistance (deltaMr/Mr), a S/N ratio, and the value of PW50 are shown in the following table 1.
[0030]
[Table 1]
表 1

実施例	Hk／4πMs	ΔMr／Mr				So/Nm (dB)	PW50 (nm)
		6000 秒後	9000 秒後	1000000 秒後	100000000 秒後		
1－1	6.63	0.917	0.879	0.000	0.000	22.2	132
1－2	5.654206	0.986	0.979	0.091	0.000	23.1	124
1－3	5.03	0.997	0.996	0.642	0.000	24.2	119
1－4	4.98	0.999	0.999	0.892	0.000	25.3	98
1－5	4.63	1.000	1.000	0.999	0.933	26.2	97
1－6	2.96	1.000	1.000	1.000	0.961	27.3	99
1－7	2.8	1.000	1.000	1.000	0.979	28.2	95
1－8	2.49	1.000	1.000	1.000	0.984	28	97
1－9	2.09	1.000	1.000	0.994	0.575	26.8	98
1－10	1.9	0.996	0.994	0.514	0.000	24.2	123
1－11	1.82	0.990	0.984	0.174	0.000	23.8	129

[0031] The graphical representation which expresses the relation between Hk/4piMs, and deltaMr/Mr to drawing 3 is shown.
[0032] Among drawing, when deltaMr/Mr of 201 is 6000 seconds, in the case of 9000 seconds, 202 is a graph with which 203 expresses respectively the estimate of change of the amount of magnetization 108 seconds the 106-second back of 1x, and after 1x.
[0033] Although it was the grade which can almost disregard change of Mr when were asked for the relation of the time change of Mr by Hk/4piM, and Hk/4piMs was 2-5 so that it might illustrate, it turns out that Hk/4piMs is smaller than 2, or a big change of Mr is seen when larger than 5, and heat fluctuation resistance is inferior.
[0034] Although the variation of magnetization is less than 10% after [of 1x] 106 seconds in the case of 2<4piMs<5 when change of the amount of magnetization 108 seconds the 106-second back of 1x and after 1x is presumed from change of Mr for 6000 seconds and 9000 seconds Rapidly, variation became large, and after [of 1x] 108 seconds, although the variation of magnetization was it less than 10% that it was 2.5<4piMs<4.5, other than this, the result expected that variation becomes large rapidly then was obtained.
[0035] Although the variation of magnetization became [when Hk/4piMs was smaller than 2, or] small when Hk/4piMs was larger than 5, and Hk was enlarged more, 0WM was falling like the result shown in drawing 2 in this case.
[0036] At MH loop shape measured by VSM of each medium, when Hk/4piMs was 2-5, the portion of the shoulder of a perpendicular MH loop had little whom, and it had become the configuration on which the portion of the shoulder of a perpendicular MH loop wears whom and a radius of circle by the other medium.
[0037] Corresponding to this, also about medium S/Nm, when Hk/4piMs was 2-5, S/N 25dB or more was obtained, and also about Pw50 (nm), when Hk/4piMs was 2-5, it became 100nm or less and a good value.
[0038] The above result showed that the medium which are 2<Hk/4piMs<5 and preferably referred to as 2.5<Hk/4piMs<4.5, and was excellent in heat fluctuation resistance was obtained in the value of Hk/4piMs as a property of perpendicular magnetic anisotropy films.
[0039] An above-mentioned magnetic-recording medium is applicable to the following magnetic recorder and reproducing devices.

[0040] The perspective diagram which understood a part of example of the magnetic recorder and reproducing device which starts this invention at drawing 5 is shown.
[0041] The spindle 122 is equipped with the magnetic disk 121 of ****** for recording the information concerning this invention, and a rotation drive is carried out at a fixed rotational frequency by the spindle motor which is not illustrated. The slider 123 in which the magnetic head which accesses a magnetic disk 121 and performs informational record reproduction was carried is attached at the nose of cam of a suspension 124 which consists of sheet metal-like flat spring. The suspension 124 is connected to the end side of the arm 125 which has the bobbin section holding the drive coil which is not illustrated etc.
[0042] The voice coil motor 126 which is a kind of a linear motor is formed in the other end side of an arm 125. The voice coil motor 126 consists of a drive coil which was able to be wound up in the bobbin section of an arm 125 and which is not illustrated, and a magnetic circuit constituted with the permanent magnet and opposite yoke which have been countered and arranged so that it may be put.
[0043] An arm 125 is held by the ball bearing which was prepared in two upper and lower sides of the fixed shaft 127 and which is not illustrated, and a rotation rocking drive is carried out with a voice coil motor 126. That is, the position of the slider 123 on a magnetic disk 121 is controlled by the voice coil motor 126. In addition, 128 show the lid among drawing 2 .
[0044]
[Effect of the Invention] according to this invention, the value of Hk/4piMs is specified to 2 or 5, and heat fluctuation resistance is improved by making the fluctuation resistance of a magnetic-film particle equalize, without raising a head magnetic field -- making -- record -- the good magnetic-recording medium for vertical recording methods of resolution and medium S/N is obtained
[0045] moreover, according to this invention, the value of Hk/4piMs is specified to 2 or 5, and heat fluctuation resistance is improved by making the fluctuation resistance of a magnetic-film particle equalize, without raising a head magnetic field -- making -- record -- the magnetic recorder and reproducing device in which the good vertical recording of resolution and medium S/N is possible is obtained

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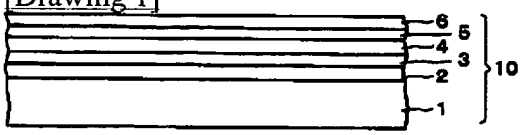
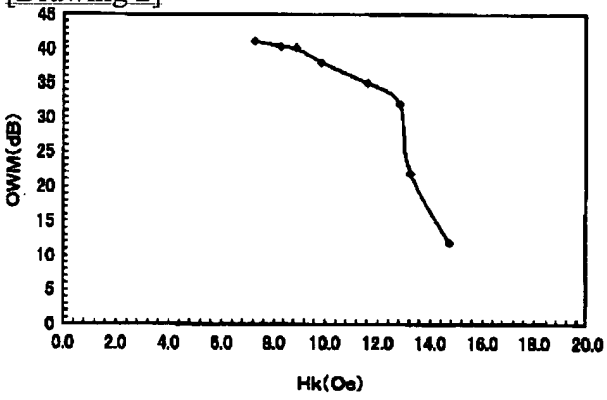
DRAWINGS

[Drawing 1]



[Drawing 2]



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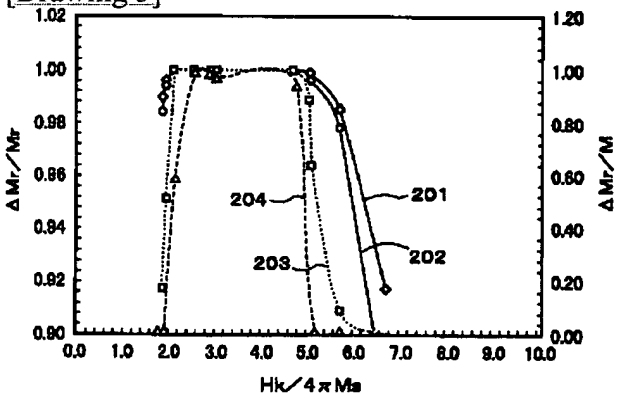
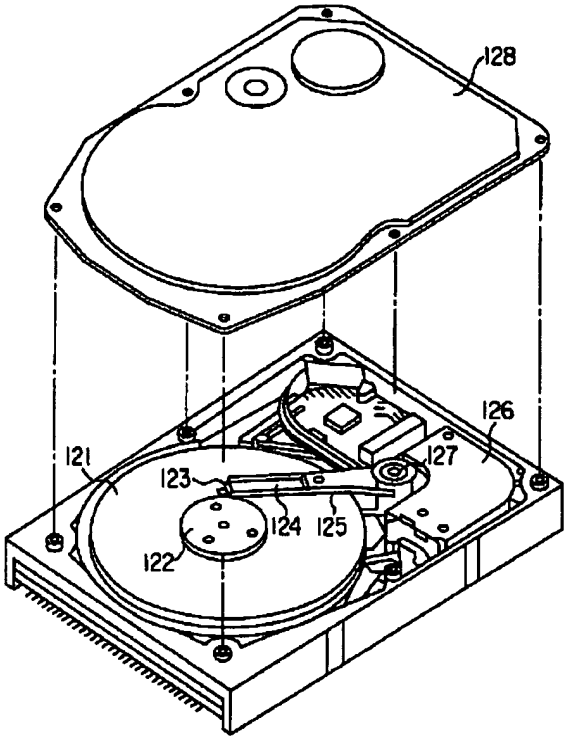


[Drawing 4]



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